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भाग 4 कार्यकारिता परीक्षण विधियाँ

(पहला पुनरीक्षण)

Indian Standard

ROTARY SHAFT LIP TYPE SEALS

PART 4 PERFORMANCE TEST PROCEDURES

(First Revision)

ICS 23.100.60; 83.140.50

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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NATIONAL FOREWORD

This Indian Standard (Part 4) (First Revision) which is identical with ISO 6194-4 : 1999 'Rotary shaft lip type seals — Part 4 : Performance test procedures' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Gasket and Packing Sectional Committee and approval of the Mechanical Engineering Division Council.

This standard was first published in 2000. ISO 6194-4 : 1988 has been replaced by ISO 6194-4 : 1999. This revision is providing the better opportunity to manufacturers to export and the users to have product of the internationally accepted quality.

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker, while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 48 : 1994 Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)	IS 3400 (Part 2) : 2003 Method of test for vulcanized rubber: Part 2 Rubber vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)	Identical
ISO 188 : 1982[1] Rubber, vulcanized — Accelerated ageing and heat resistance tests	IS 3400 (Part 4) : 1987 Method of test for vulcanized rubber: Part 4 Rubber, vulcanized — Accelerated ageing and heat resistance tests	Technically Equivalent
ISO 815 : 1972[2] Rubber, vulcanized or thermoplastic — Determination of compression set at ambient, elevated or low temperatures	IS 3400 (Part 10) : 1977 Method of test for vulcanized rubber: Part 10 Rubber, vulcanized or thermoplastic — Determination of compression set at ambient, elevated or low temperatures	do
ISO 1432 : 1988 Rubber, vulcanized or thermoplastic — Determination of low temperature stiffening (Gehman test)	IS 3400 (Part 18) : 1995 Method of test for vulcanized rubber: Part 18 Rubber, vulcanized or thermoplastic — Determination of low temperature stiffening (Gehman test)	do

(*Continued on third cover*)

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[1] Revised in 1998.

[2] Revised in 1991.

Indian Standard

ROTARY SHAFT LIP TYPE SEALS

PART 4 PERFORMANCE TEST PROCEDURES

(First Revision)

1 Scope

This part of ISO 6194 specifies test requirements for rotary shaft lip type seals. The tests may be used for qualification purposes. Materials quality control, dynamic testing and supplementary low temperature testing requirements are also covered.

2 Normative references

The following normative documents contains provisions which, through reference in this text, constitute provisions of this part of ISO 6194. For dated references, subsequent amendments to, or revisions of, these publication do not apply. However, parties to agreements based on this part of ISO 6194 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 48:1994, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD).*

ISO 188:1998, *Rubber, vulcanized — Accelerated ageing and heat resistance tests.*

ISO 815:1991, *Rubber, vulcanized or thermoplastic — Determination of compression set at ambient, elevated or low temperatures.*

ISO 1432:1988, *Rubber, vulcanized or thermoplastic — Determination of low temperature stiffening (Gehman test).*

ISO 1817:1998, *Rubber, vulcanized — Determination of the effect of liquids.*

ISO 2781:1988, *Rubber, vulcanized — Determination of density.*

ISO 2921:1997, *Rubber, vulcanized — Determination of low-temperature characteristics — Temperature-retraction procedure (TR test).*

ISO 5598:1985, *Fluid power systems and components — Vocabulary.*

ISO 6194-1:1982, *Rotary shaft lip type seals — Part 1: Nominal dimensions and tolerances.*

ISO 6194-2:1991, *Rotary shaft lip type seals — Part 2: Vocabulary.*

3 Terms and definitions

For the purposes of this part of ISO 6194, the terms and definitions given in ISO 6194-2 and ISO 5598 and the following definition apply.

3.1
batch
identifiable and traceable consignment of rubber compound of definite composition and manufactured in a single production operation

4 Pre-test procedure

4.1 Inspect all seals submitted for testing for conformity to a relevant drawing or detailed specification declared by the seal manufacturer.

4.2 For seals with an elastomeric component, ensure that the seal manufacturer has stated the material designation batch number from which the seals have been made, together with the nominal density, nominal hardness, maximum compression set value and maximum mass change after immersion in the test fluid.

Where the seal is required for the low temperature stiffness test, ensure that the seal manufacturer has also stated the maximum modulus after test at the selected test temperature.

Ensure that the batch of elastomer has been tested in accordance with clause 7.

4.3 To facilitate accurate analysis of the test results, determine the following data concerning the physical characteristics of the seal and test apparatus before testing:

a) lip diameter (with spring);

b) lip diameter (without spring, measured not less than 24 h after removal of spring);

c) outer case mean diameter and out-of-roundness;

d) shaft diameter, material hardness and surface roughness;

e) housing diameter, material and surface roughness;

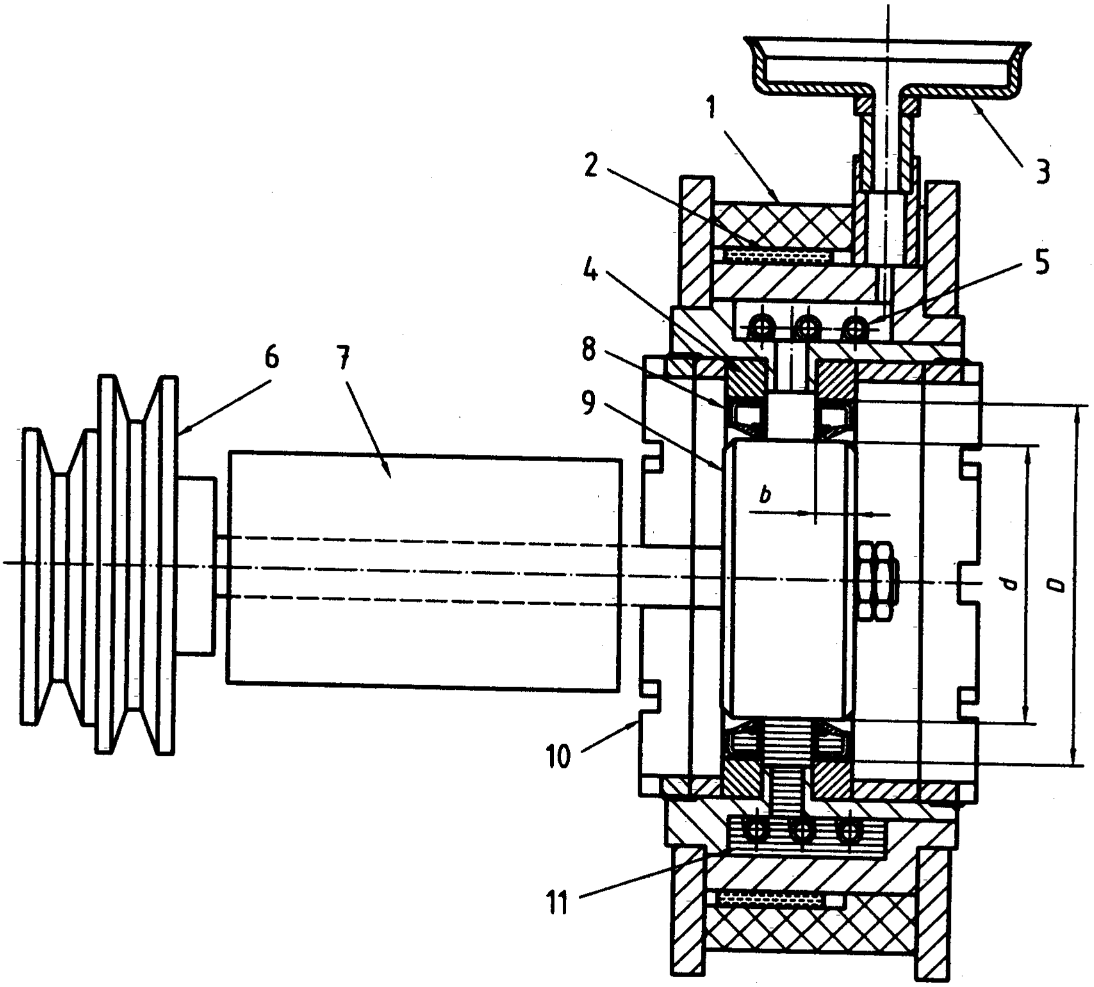
f) minor lip diameter, where applicable (with and without primary lip spring fitted).

4.4 Ensure that the specified shaft eccentricity and housing off-set of the test apparatus have been incorporated.

5 Dynamic test

5.1 Test apparatus

The test apparatus shall be similar to the typical example shown in Figure 1 and shall consist of a suitable housing for retaining the test fluid and for positioning the test seals, as well as a rotating member having a spindle mounted horizontally on suitable bearings. The design of the housing for the seal shall be in accordance with the dimensions specified in ISO 6194-1. The housing and the rotating member shall be capable of reproducing the eccentricity and off-set specified in 4.4.



Key

1	Insulation
2	Heater band
3	Filler tray
4	Seal housing
5	Cooling coils
6	Drive from prime mover
7	Test head support
8	Test seal
9	Test shaft
10	Locking ring
11	Test fluid

Figure 1 — Typical example of dynamic test apparatus

Where it is not practicable to provide a test apparatus with the particular shaft and housing size relevant to the application, the test apparatus shall be selected from the standard sizes listed in Table 1. The size selected shall be that nearest to the application size.

Table 1 — Standard shaft and housing dimensions

Dimensions in millimetres

Shaft diameter *d*	Housing diameter *D*	Seal width *b*
20	35	7
40	55	8
60	80	8
90	120	12
200	230	15

The test apparatus shall also conform to the following additional requirements:

a) the shaft shall be capable of cycling and/or maintaining the shaft speeds to within ± 3 %;

b) the shaft shall be capable of maintaining the specified test eccentricity under dynamic conditions to within ± 0,03 mm throughout each test;

c) the test head shall be designed and constructed so as to maintain the housing bore alignment relative to the test shaft axis within 0,03 mm throughout the operating temperature range;

d) the design of the test head support shall ensure minimum deformation and vibration;

e) the test head and heat transfer system shall be capable of maintaining the temperature of the test fluid within ± 3 °C, and shall be vented to atmosphere;

f) heat shall be applied in a manner that does not subject the test fluid to high localized temperatures that could cause fluid decomposition;

g) the test shaft shall have a surface that is free of helical machine marks and shall comply with the requirements for shafts specified in ISO 6194-1;

h) the test housing bore shall comply with the requirements specified in ISO 6194-1;

i) the materials, surface finish and dimensions of the test shaft and test housing bore shall conform as closely as possible to the shaft and housing bore to be used in service;

j) a minimum quantity of 0,75 l of test fluid shall be used;

k) the level of the test fluid in the test head shall be $0,3d$ to $0,5d$ above the lowest point of the shaft diameter d;

l) for seal housings with inboard bearings, the test housing shall be suitably relieved at the bearing supports to prevent excessive fluid pressure between the bearing and seals;

m) means shall be provided for collecting and measuring the mass of any fluid leakage from the seals during the test;

n) the test head shall have a device capable of pressurising the seal housing to the working pressure;

o) a liquid level measuring device shall be provided on the test head.

5.2 Installation

5.2.1 Thoroughly clean the test head of contaminants and extraneous matter.

5.2.2 Install the seal into the test head so that the cumulative eccentricities of the seal and the test head are known.

5.2.3 Ensure that the plane of the seal lip is perpendicular to the shaft axis, unless otherwise specified.

5.2.4 Locate the test shaft in such a position that a clean unused area of its surface is in contact with the sealing element of the test seal.

5.3 Test conditions

Apply test conditions that simulate the seal application operating conditions specified by the customer, i.e. normal operating temperature, normal operating shaft speed, maximum envisaged operating temperature and maximum envisaged shaft speed (see annex A).

5.4 Test procedure

Submit six seals to 10 cycles, each of 24 h duration, consisting of 14 h at normal operating temperature and speed, according to service conditions, and 6 h at the maximum envisaged operating temperature and speed, followed by a 4 h shut-down when the test machine is allowed to cool to room temperature. If applicable, each alternate cycle shall be in the reverse direction of rotation.

5.5 Post-test measurements

After completion of the test, determine the seal lip diameters, the minor lip diameters where applicable, and the contact band width. Inspect the seal lip, noting any cracks, tears, splits or any imperfections that may have appeared as a result of the test.

5.6 Recording

Record all test data on a seal test report. An example of a seal test report for a dynamic test is shown in annex A.

5.7 Acceptance criteria

Unless otherwise agreed between manufacturer and purchaser, the total leakage from all six seals shall not be greater than 12 ml, and the leakage from any single seal shall not be greater than 3 ml.

6 Dynamic low temperature test

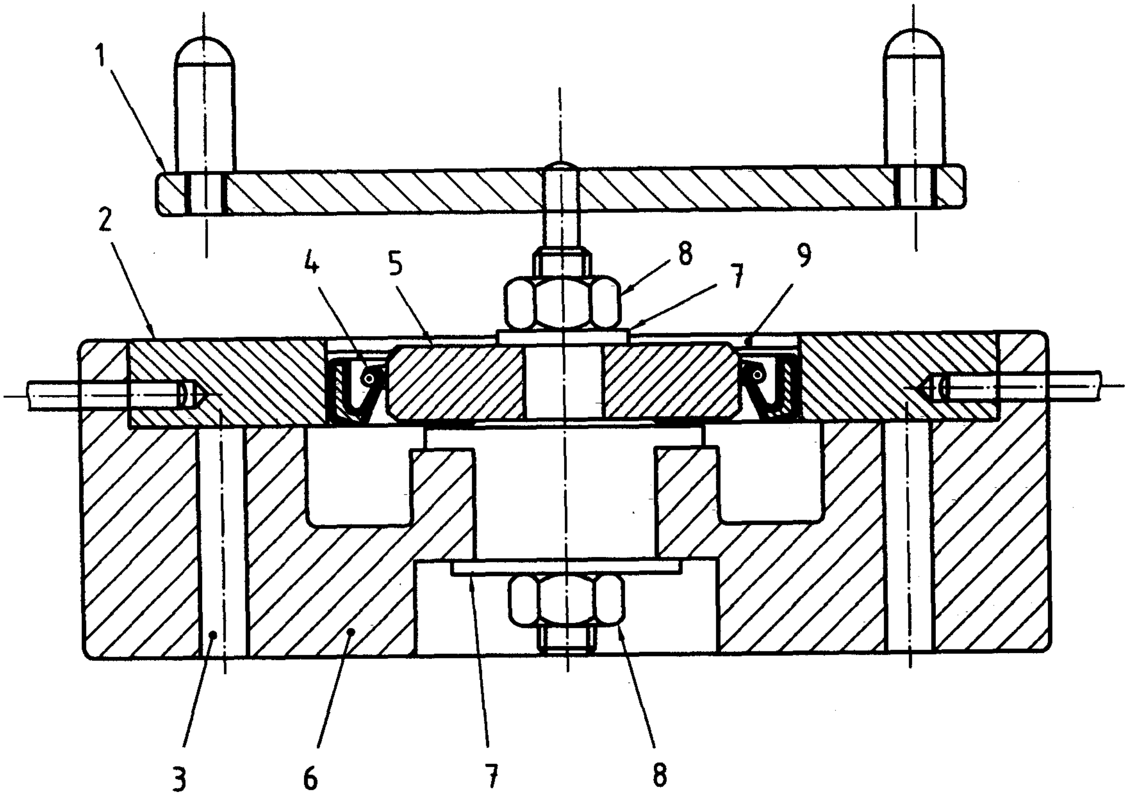
6.1 General

This test is applicable to all rotary shaft lip type seals for which the minimum specified operating temperature is stated to be – 10 °C or lower.

6.2 Test fixture

The test fixture shall be similar to the typical example shown in Figure 2.

The test shaft and seal housing shall simulate the envisaged maximum eccentricities specified by the customer. The test shaft diameter, the test shaft surface roughness and seal housing dimensions shall also be those specified by the customer or as specified in ISO 6194-1.



Key

1	Handle	5	Test shaft
2	Seal housing	6	Base
3	Holes to locate with pins in base plate of refrigeration unit	7	Washer
		8	Plain hexagonal nut
4	Test seal	9	Test fluid

Figure 2 — Typical example of low temperature test fixture

6.3 Installation

The requirements of 5.2.1, 5.2.2 and 5.2.3 shall be followed.

6.4 Test procedure

Submit two seals to the following procedure.

6.4.1 Soak the seal in test fluid for 70 h at normal operating temperature (see annex B).

6.4.2 Remove the seal from the test fluid and shake off the excess. Do not blot dry.

6.4.3 Lubricate the test shaft with a small quantity of the test fluid.

6.4.4 Correctly locate the seal in the test fixture.

6.4.5 Fill the test fixture with the test fluid to submerge the wetted side of the seal lip.

6.4.6 Place the test fixture in a cold box and soak for 16 h at the minimum temperature specified by the customer (see annex B).

6.4.7 With the test fixture still in the cold box, rotate the shaft 10 revolutions by hand in the clockwise direction at an approximate speed of 1 Hz, pausing once every 180°.

6.4.8 Remove the text fixture from the cold box and allow to stand at room temperature for a minimum period of 6 h.

6.4.9 Remove the seal from the test fixture.

6.5 Post-test measurements

Inspect for leakage that may have occurred during the test and visually inspect seal lip, noting any cracks, tears, splits or any imperfections that may have appeared as a result of the test.

6.6 Recording

Record all test data on a seal test report. An example of a seal test report for the dynamic low temperature test is shown in annex B.

6.7 Acceptance criteria

There shall be no visible damage to lip and there shall be no leakage greater than that specified by the customer.

7 Material testing of elastomeric components

7.1 Elastomeric material requirements

Each batch of material from which the test seals are manufactured shall be tested for the purpose of quality control. In order to ensure that the material used for production seals does not vary significantly from that of the dynamic test seals, subsequent production batches shall also be tested on a random sample basis. The materials used for tests shall be in an unused condition.

Tests shall be in accordance with 7.2 to 7.7.

7.2 Density

Each batch of material shall be tested in accordance with ISO 2781.

The result shall be the specified nominal density (see 4.2) within a tolerance of ± 0,03 g/cm^3 for all materials.

7.3 Hardness

Each batch of material shall be tested in accordance with ISO 48.

If the dimension of the test piece is greater than 4 mm then the normal test procedure shall be used. If less than 4 mm, then the microtest procedure shall be used.

The result shall be the specified nominal hardness (see 4.2) within a tolerance of ± 7 IRHD.

7.4 Compression set

Each batch of material shall be tested in accordance with ISO 815.

The duration of the test shall be 22 h, and the temperature of the test for different elastomers shall be as given in Table 2.

The result shall be not greater than the specified maximum value (see 4.2).

Table 2 — Recommended test temperatures

Elastomer	Temperature °C
Nitrile	100
Hydrogenated nitrile	150
Polyacrylate	150
Fluorocarbon	200
Silicone	200

7.5 Fluid immersion

Each batch of material shall be tested in accordance with ISO 1817.

The duration of the test shall be 22 h, and the temperature of immersion for each material shall be as listed in Table 2. The test fluid shall be oil type 1 as specified in ISO 1817.

The change in volume shall be within ± 2 % of the nominal change in volume specified by the seal manufacturer, unless otherwise agreed between manufacturer and purchaser.

7.6 Dry heat ageing in air

Each batch of material shall be tested in accordance with ISO 188, using an air oven method.

The duration of the test shall be 168 h, and the temperature of the test for different elastomers shall be as given in Table 2.

The test specimens shall be similar to those used for the hardness test (see 7.3).

The apparent hardness after test shall be within ± 10 IRHD of the hardness recorded prior to test.

7.7 Stiffness at low temperature

Where the minimum operating temperature is stated to be –10 °C or lower, each batch shall be tested in accordance with ISO 1432 or ISO 2921 (as agreed between manufacturer and purchaser) at the lower specified test temperature (see 4.2), i.e. – 10 °C, – 20 °C or – 40 °C.

When in accordance with ISO 1432, the modulus after test shall be not greater than the specified maximum value (see 4.2).

7.8 Recording

Record all test data on a material test report, an example of which is given in annex C.

Annex A
(informative)

Example of a seal test report for the dynamic test

A.1 General data

Test report reference:

Seal drawing reference or specification:

Seal type:

Elastomer	Compound:	Batch No:

A.2 Pre-test measurement

Test seal No.								
Seal lip diameter	without spring:	mm						
	with spring:	mm						
Seal outer case	mean diameter:	mm						
	out of round:	mm						
Minor lip diameter (where applicable)	without primary lip spring:	mm						
	with primary lip spring:	mm						

A.3 Test conditions

Test fluid:	Description:		
	Normal operating temperature:	°C	ISO viscosity grade:
	Max. operating temperature:	°C	ISO classification:

Shaft:	Diameter: mm	Material:
	Hardness:	Surface roughness, *Ra*: µm
	Eccentricity (TIR[1]): mm	Normal operating speed: r/min
		Max. operating speed: r/min

Housing:	Diameter: mm	Material:
	Off-set mm	Surface roughness, *Ra*: µm

Test cycle (if different from 5.4):

A.4 Post-test measurement

Test seal No.							
Seal lip diameter	without spring: mm						
	with spring: mm						
Wiper lip diameter (where applicable)	without primary lip spring: mm						
	with primary lip spring: mm						

A.5 Test results

Test seal No.:							All seals:
Leakage: ml							Total: ml

Comments on seal condition, before and after test:

---

[1] Total indicator reading.

Annex B
(informative)

Example of a seal test report for the dynamic low temperature test

B.1 General data

Test report reference:

Seal drawing reference or specification:

Seal type:

Elastomer	Compound:	Batch No:

B.2 Pre-test measurement

Test seal No.								
Seal lip diameter	without spring:	mm						
	with spring:	mm						
Seal outer case	mean diameter:	mm						
	out of round:	mm						
Minor lip diameter (where applicable)	without primary lip spring:	mm						
	with primary lip spring:	mm						

B.3 Test conditions

Test fluid:

Description:		
Normal operating temperature:	°C	ISO viscosity grade:
Max. operating temperature:	°C	ISO classification:
Min. operating temperature:	°C	

Shaft:

Diameter: mm	Material:
Hardness:	Surface roughness, *Ra*: µm
Eccentricity (TIR): mm	Normal operating speed: r/min
	Max. operating speed: r/min

Housing:

Diameter: mm	Material:
Off-set mm	Surface roughness, *Ra*: µm

Test cycle (if different from 6.4):

B.4 Test results

Test seal No.:		
Leakage: ml		

Comments on seal condition, before and after test:

Annex C
(informative)

Example of a material test report

C.1 General data

Test report reference:

Seal drawing reference or specification:

Seal type:

Elastomer	Compound:	Batch No:
	Type:	

C.2 Test conditions

Compression set

Time: 22 h

Temperature: °C

Fluid immersion

Test fluid:

Dry heat ageing in air

Time: 168 h

Temperature: °C

Stiffness at low temperature:

Temperature: °C

C.3 Test results

Density:	Required:	Results:
Hardness:	Required:	Results:
Compression set:	Required:	Results:
Fluid immersion:	Required:	Results:
Dry heat ageing:	Required:	Results:
Stiffness at low temperature:	Required:	Results:

C.4 Comments

Bibliography

[1] ISO 5163:1990, *Motor and aviation-type fuels — Determination of knock characteristics — Motor method.*

[2] ISO 5164:1990, *Motor fuels — Determination of knock characteristics — Research method.*

(*Continued from second cover*)

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 1817 : 1999[1] Rubber, vulcanized — Determination of the effect of liquids	IS 3400 (Part 6) : 2005 Method of test for vulcanized rubber: Part 6 Rubber, vulcanized — Determination of the effect of liquids	Technicaly Equivalent
IS 2781 : 1988 Rubber, vulcanized — Determination of density	IS 3400 (Part 9) : 2003 Method of test for vulcanized rubber: Part 9 Rubber, vulcanized — Determination of density	Identical
ISO 5598 : 1985 Fluid power systems and components — Vocabulary	IS 10416 : 1992 Fluid power systems and components — Vocabulary (*first revision*)	do
ISO 6194-1 : 1982 Rotary shaft lip type seals — Part 1 : Nominal dimensions and tolerances	IS 5129 (Part 1) : 2000 Rotary shaft lip type seals: Part 1 Nominal dimensions and tolerances (*third revision*)	do
ISO 6194-2 : 1991 Rotary shaft lip type seals — Part 2 : Vocabulary	IS 5129 (Part 2) : 2000 Rotary shaft lip type seals: Part 2 Vocabulary	do

The technical committee has reviewed the provisions of the following International Standard referred in this adopted standard and has decided that it is acceptable for use in conjunction with this standard:

International Standard	*Title*
ISO 2921 : 1997	Rubber, vulcanized — Determination of low-temperature characteristics — Temperature-retraction procedure (TR test)

This standard consists of five parts which are identical to ISO 6194 series. The other parts are as under:

Part 1	Nominal dimensions and tolerances
Part 2	Vocabulary
Part 3	Storage, handling and installation
Part 5	Identification of visual imperfections

Annexes A, B and C of this standard are for information only.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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[1] Revised in 2005.

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Amendments Issued Since Publication

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